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ENGINEERING RECORDS IN THE RAILWAY OPERATING
DEPARTMENT.

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(To be read on Thursday, May 31st, 1900.)

When, on completion of construction, a railway is turned over to the operating department, it is generally found that the maps, profiles and other records are far less complete than generally supposed. Even with very careful location, the unevenness of the ground, obstructions from trees and changes made during construction, introduce inaccuracies in distance, breaks in chainage caused by changes of alignment increase or decrease length of line and are difficult to keep account of.

The profiles also have been made with differing datum and changes of grade made at the last moment, are often unrecorded.

Sidetracks, buildings, water tanks, etc., are seldom definitely located until construction is nearly complete, and not generally until after the general construction work is finished.

Altogether, even at the best, the plans and records are more or less deficient.

Sometimes, also, a railway company acquires an old line from another company, or several short lines are amalgamated; in these cases it is often found that the records are almost altogether lacking, or are in a very incomplete and unreliable condition. Often the engineer in charge will find that he will have to get along the best way he can with the information available, making special surveys as the necessity arises; these surveys will be made in a hurry for some special purpose and will be of little or uncertain value for other uses. Surveys of this kind accumulate, made by different parties for different purposes, with varying degrees of accuracy, and after a time it is seldom known how much reliance can be placed in them; in consequence it is often necessary to revisit

the ground and make new surveys; a great amount of work has to be done, which would have been unnecessary if reliable plans existed.

The remedy for this state of affairs is a complete re-survey of the whole road, especially when it is an important road in a thickly settled country, with towns and villages at short intervals.

On a railway in the Central States, with which the writer was employed, it was decided to make a complete re-survey, the line having been recently acquired from another company; the few existing plans were incomplete and disconnected, a great amount of uncertainty existed as to the company's title to right of way and other property, and it was also proposed to expend a considerable sum in improving alignment and grades, accurate plans and profiles being needed for this purpose.

The railway was first carefully measured from end to end, starting with zero at one terminus; a 100-foot steel tape was used; each hundred-foot station was marked with white paint on the inside of the rail; every tenth station was referenced by an oak stake, 3 inches square, set $7\frac{1}{2}$ feet from the centre line; stakes were also set at every mile, to be afterwards replaced by standard mile posts. After the measurement was completed, the line was gone over by the transit party. This party made a traverse of the line, not stopping to run tangents to intersection and put in curves, simply getting a record of the centre line of the track, as they found it on the ground. On tangents, a sight would be taken on the track ahead as far as visible, and a straight line run, any deflection in the track being noted.

The intersection of all township, section, quarter-section and property lines were obtained, the angles recorded, and distances measured to the nearest section or quarter-section corners, one member of the party being employed most of his time in looking up monuments.

Plusses to points of intersection were obtained from the stations marked on rails by the measuring party.

A record was made of the fences on each side of the right of way, and distance from the centre line, this being often important as a means of determining a disputed boundary, where the fence had been in existence for a long period, as many deeds did not state the width of the right of way.

In villages and towns, the streets and lots adjacent to the company's property were located; all important factories, with the tracks leading to them, even if on a foreign railroad, and all sidings and structures on the company's property, particular attention being given to apparent encroachments, it being often found that buildings were wholly or partially on the company's property

without any lease having been made. In making a survey through a village or town, the transit party was furnished with copies of the official plates, previously obtained at the county seat, to aid them in locating lines and streets.

The transit party measured all bridges, buildings, culverts and other structures, located all "Y" and railroad crossings, and public and private road crossings.

The level party followed, taking levels at every hundred-foot station, on top of tie, at ends of bridges, on railway crossings, of level of water in streams, and approximate levels of adjacent ground. Check levels were run and bench marks established at about half mile intervals, and oftener at places likely to be needed. Levels were connected with sea levels taken from United States Government surveys. The plans were drawn on white drawing paper in sheets, on a scale of 400 feet to an inch, each sheet showing the line across a square mile section of land, a whole section or two adjoining half-sections being shown on the sheet.

The top of sheet was north in every case, all distance and angles obtained on the ground to section and property lines were recorded on the sheets.

On top of each sheet was a plain title giving number of section, township and range.

All deeds and agreements were carefully gone over and compared with the plans, right of way coloured in red, with name of grantor, page, and number of record book, and any conditions in deeds noted on plans. Villages and towns, where the scale of 400 feet to an inch did not allow sufficient detail to be shown, were drawn also on a scale of 100 feet to an inch, a large town often requiring several sheets, the same ground being covered, with less detail, on the smaller scale.

The sheets, when completed, were numbered and bound together by counties, the first page being devoted to title and the second to an index map of the county, showing the route of the railway.

The centre line was drawn in red ink, all station numbers and plusses being also in red; distances and all lettering were shown in black.

Before binding, all the plans were copied on tracing linen.

The profiles were drawn on the usual scales of 400 feet to an inch horizontal, and 30 feet to an inch vertical.

In cases where the engineer is unable to have a complete re-survey made, it will be advisable, as time permits, to make accurate surveys of all yards and station grounds, depending for general details of alignment outside these limits on the existing right of way maps.

If an accurate set of yard and station ground plans are obtained

to start with, it will be a comparatively easy matter to keep them correct as changes are made.

A statement should be prepared, giving length of all sidings, spurs and "Ys," made from actual measurements, and not from foremen's reports. The form can be made with several blank columns to be filled in from time to time, with "Track laid during —," "Track taken up during —," "Total length on —." This statement will show at a glance length of track on any siding, and avoid a search on plans and profiles for the information.

A chart, showing graphically the different makes, weights and date when laid, of the rails in use should be made, and corrected as new rails are laid.

A bridge book should be kept, devoting a page to each bridge or trestle, giving style, spans, size of stringers, when built, when repaired or rebuilt, conditions when inspected, etc.

A record should be kept of all leases of the company's property, a copy of lease and plat filed.

Detailed statements should be kept of the actual cost of all structures built, and, on completion, plans made showing the structure actually as built, showing depth and character of foundations of bridges, retaining walls, etc., and all differences from the original designs. A condensed plan and profile may be prepared when time permits, showing a great amount of general information, useful in the track and operating departments. The scale will depend somewhat on the length of line it is desired to represent, but, even on a scale as small as one mile to an inch horizontal, and 100 feet to an inch vertical, the principal grades, sections, mileage, water tanks, sidings, railway crossings, etc., can be shown.

The plan will probably have to be somewhat distorted in order to keep it on same paper as the profile, and lengths of sidings and size of structures exaggerated. The arrangement can be somewhat as follows:

On top a series of lines showing number of telegraph wires; lines showing the fencing, the mileage and the track sections; below this, a plan or graphical chart of the line, showing general geography and alignment, degree of each curve being shown by figures. Then the profile, showing bridges, grades, stations, etc.; below the profile a series of lines showing rails, joints, ballast, and new rails, new joints, new ballast.

An important matter is a system of filing plans so they can be quickly found when needed. When blue prints are much used, it is best to file the tracings. When plans are numerous a card index will be found most convenient. A plan can be indexed on the cards under several headings, and new plans can be added and changes made without spoiling the index.

The tracings can be filed in small pigeon holes, designated by letters and numbers, at sides and top of case respectively. The objection to this method is that the tracings, being tightly rolled, are troublesome to get flat in the blue print frame; this can be avoided by filing them flat in drawers and indexing by letters and numbers in a similar manner.